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Uncommon Cretaceous Naticiform Gastropods from the Pacific Slope of North America

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Abstract. Five naticiform gastropod species, not commonly found in Cretaceous rocks on the Pacific slope of North America, are described, and their paleobiogeographic implications are discussed. The moderately large *Tylostoma* ***allisoni,*** sp. nov. of Early Cretaceous (late Aptian) age from northern Baja California, Mexico, represents the earliest record of this tylostomatid genus in North America. Restudy of the Late Cretaceous (late early to early late Maastrichtian) *Phasianella garzana* Anderson, 1958, from central California, revealed that it might be a *Tylostoma.* These two species, along with *Tylostoma*? sp. indet. of late Aptian age from northern Baja California, represent all the known occurrences of this genus from the study area. *Tylostoma* is a cosmopolitan gastropod genus that originated during the Late Jurassic in the Old World Tethys Sea region.

The very rare *Pictavia* ***santana,*** sp. nov. of Late Cretaceous (late Turonian) age from southern California represents the first and youngest record of this obscure naticiform genus in the New World. *Pictavia* originated during the Late Triassic in the Tethys Sea region.

The moderately large *Prisconatica* ***hesperia,*** sp. nov. of Late Cretaceous (late Santonian to early Campanian) age, from near Nanaimo, Vancouver Island, British Columbia, and rare in the Santa Ana Mountains, southern California, represents the first record of this obscure naticiform genus on the Pacific slope of North America, as well as its youngest and northernmost record. *Prisconatica* apparently originated during the Early Cretaceous (Albian) in the New World.

INTRODUCTION

While studying the collections of several museums that have Cretaceous fossils from the region extending from Vancouver Island, British Columbia, Canada, southward to Baja California, Mexico, we came across some mostly large, naticiform gastropods that are not commonly found in the study area. Inquiries to our colleagues in British Columbia resulted in the loan of some additional and very useful specimens.

Three genera of naticiform gastropods are represented in our study: *Tylostoma* Sharpe, 1849; *Pictavia* Cossmann, 1925; and *Prisconatica* Gabb, 1877. As will be discussed in this paper, these genera have traditionally been regarded as naticids, but now this assignment is questioned. Bandel (1999) reported that the early history of the naticids is difficult to ascertain because of unrecognized convergence in form of fossil species belonging to unrelated groups of gastropods.

Tylostoma Sharpe, 1849, is an extinct genus indicative of tropical to warm-temperature seas (Sohl, 1971; Kollmann, 1992). Although it was widespread during the Cretaceous, only two species have been previously reported (Allison, 1955) from the Pacific slope of North America. These species are from strata that Allison originally reported as being middle Albian, but later (Allison, 1974) refined as being upper Aptian. Our restudy of Allison's original material, as well as additional specimens found in museum collections, revealed that one of these species is *Tylostoma* ***allisoni,*** sp. nov. and the other is *Tylostoma*? sp. indet.

The record of *Tylostoma* is herein tentatively extended into California, based on the recognition of a rare species, *Tylostoma*? *garzana* (Anderson, 1958), described as a *Phasianella* Lamarck, 1804, from upper lower to lower upper Maastrichtian strata of central California.

Pictavia Cossmann, 1925, as will be discussed later, was predominantly known from Jurassic strata in the Old World. The paleobiogeographic range of this genus is herein tentatively extended to the Pacific slope of North America, based on the discovery of the very rare *Pictavia* ***santana,*** sp. nov. in upper Turonian rocks in southern California.

The paleontologic record of *Prisconatica* Gabb, 1877, is sparse. As will be discussed later, it is apparently re-

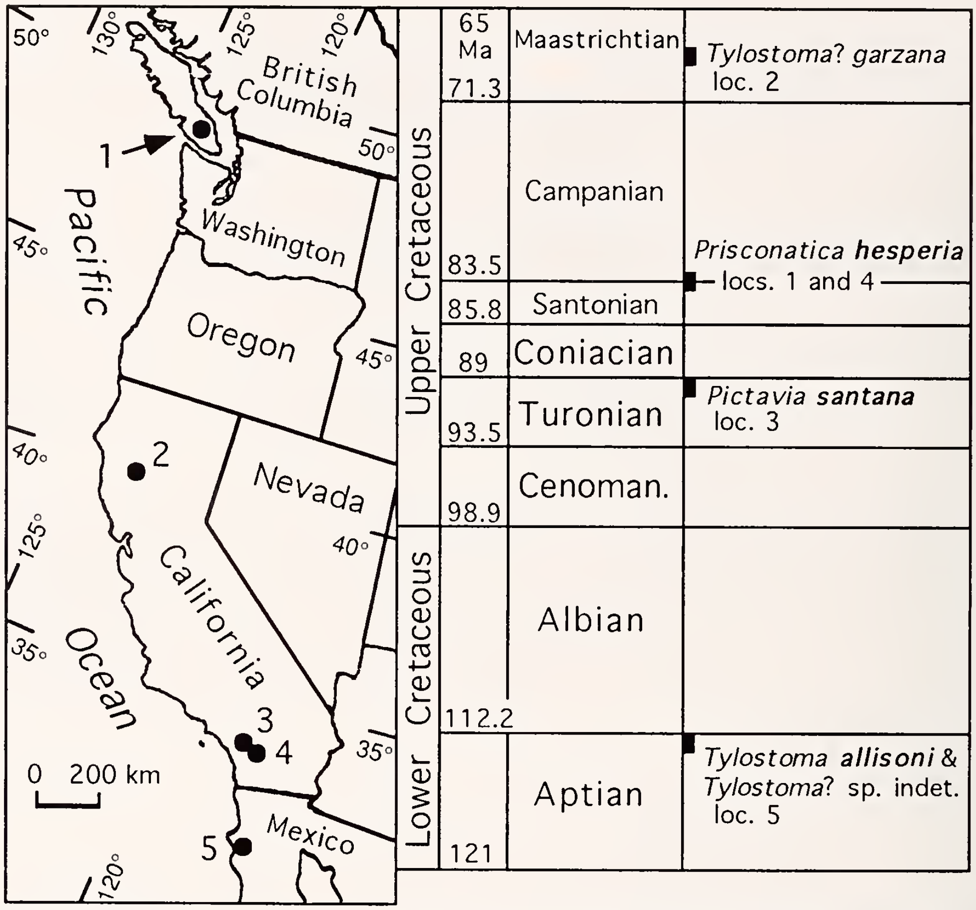


Figure 1. Locator map and chronostratigraphic positions of the new and restudied Late Cretaceous gastropods. Geologic ages from Gradstein et al. (1994). 1 = Brannen Lake. 2 = Los Banos Creek. 3 & 4 = Santa Ana Mountains. 5 = Punta China.

stricted to Cretaceous rocks of the New World. The paleobiogeographic range of this genus in North America is herein extended to the Pacific slope of North America, based on the recognition of *Prisconatica* ***hesperia,*** sp. nov. in collections from the uppermost Santonian to lower Campanian strata of Vancouver Island, British Columbia, and from lower Campanian strata in southern California. These specimens, which are locally moderately common, represent the youngest species of *Prisconatica.*

The objectives of this paper are to describe and illustrate the above-mentioned naticiform species and to determine or update their stratigraphic occurrences. This paper establishes more fully the paleontologic record of *Tylostoma* on the Pacific slope of North America and also establishes for the first time in this area, the occurrence of *Pictavia* and *Prisconatica.* All of this new information significantly extends the paleobiogeographic ranges of these uncommon gastropods.

The geologic ages and depositional environments of the study area formations and members cited in this present paper have been summarized in recent papers by Squires & Saul (2001, 2003) and Saul & Squires (2003). The locales and stage occurrences of the new species and restudied species are shown in Figure 1. Morphological terms used here are defined by Cox (1960) and Linsley (1977). Abbreviations used for catalog and locality numbers are: CAS, California Academy of Sciences, San Francisco; GSC, Geological Society of Canada, Vancouver; LACMIP, Natural History Museum of Los Angeles County, Invertebrate Paleontology Section; RBCM, Royal British Columbia Museum, Victoria; SDSNH, San Diego Society of Natural History, San Diego; UCMP, University of California Museum of Paleontology (Berkeley); VIPM, Vancouver Island Paleontological Museum at Qualicum Beach, British Columbia.

PALEOBIOGEOGRAPHY

Tylostoma

According to Cossmann (1925), the earliest record of *Tylostoma* is the Late Jurassic (Kimmeridgian) *Pterodonta corallina* Etallon in Loriol, 1887, from France. Although Gemmellaro (1878) named *Tylostoma rimatum, T. sellae, T. antiquum, T. zitteli,* and *T. densistriatum* from Lower Jurassic strata of Sicily, his generic assignment is not plausible. The first four are very similar to each other and appear to belong to the pseudomelaniid genus *Oonia* Gemmellaro, 1878, rather than to *Tylostoma,* because of their taller and narrower spire, wider and somewhat angular peripheral region on the last whorl, and occasionally, a well delineated anterior portion of the inner lip. "*Tylostoma*" *densistriatum* has an abapical canal, which is a morphologic feature not associated with *Tylostoma.*

By the latest Jurassic, *Tylostoma* had spread into Sicily and the Carpathian Mountains region of eastern Europe (Cossmann, 1925), and during the Early Cretaceous (Neocomian) *Tylostoma* was present in western Europe (Pictet & Campiche, 1863) and South America (Weaver, 1931; Riccardi, 1988:table 5). By the late Early Cretaceous (Aptian), *Tylostoma* had become widespread, with species known from Sinai (Abbass, 1963), Tunisia (Pervinquière, 1912; Darteville & Brebion, 1956), Japan (Nagao, 1934; Kase, 1984), Switzerland, France, and England (Cossmann, 1925), and Baja California (Allison, 1955), as well as questionably from Angola (Darteville & Brebion, 1956). Its arrival in Baja California coincided with both a global trend of rising sea level (Haq et al., 1987) and with warm and equable surface waters (Frakes, 1999). A likely dispersal route might have been by way of the easternmost Tethys (Japan) and the northern Pacific gyre. The evidence is that earlier southward occurrences are lacking in the mainland of Mexico, the Gulf Coast of the United States, and northern South America. If *Tylostoma* had arrived on the Pacific slope of North America via an equatorial route connected to the western Tethys, there should be some record of it in these low-latitude locales.

During the Albian, *Tylostoma* continued to be present in Europe (Cossmann, 1925), as well as in Tunisia and the Angola-Gabon region (Darteville & Brebion, 1956), but it also spread into central Texas (Stanton, 1947; Akers & Akers, 1997). The Albian might have been the time of peak diversity for *Tylostoma,* based on reports by Cossmann (1925) and Akers & Akers (1997), but determination of the ages of some occurrences is difficult because of imprecise stratigraphy.

Relatively few Cenomanian species of *Tylostoma* are known, but it has been reported from strata of this age in France (Cossmann, 1925) and Texas (Akers & Akers, 1997).

The Turonian nearly rivaled the Albian in terms of diversity and widespread distribution of *Tylostoma,* with species reported from Portugal (Sharpe, 1849), Gabon (Darteville & Brebion, 1956), Tunisia and Syria (Pervinquière, 1912), Egypt and Sinai (Abbass, 1963), Madagascar (Darteville & Brebion, 1956), the Caucasus Mountains of the Black Sea area and central Asia (Pchelintsev, 1951), northeastern Brazil (White, 1887; Bengston, 1983: table 3), and southern California (this paper).

Post-Turonian species of *Tylostoma* are rare. Pchelintsev (1951) reported a single species from the Santonian of central Asia. No Campanian species have been reported. The only Maastrichtian occurrence that we are aware of is *T.*? *garzana* (Anderson, 1958) from upper lower to lower upper Maastrichtian strata of central California.

Rosenkrantz (1970) reported *Tylostoma ampullariaeforme* Ravn (1902) from middle Danian strata of Denmark and Belgium, and he reported *Tylostoma* sp. aff. *T. ampullariaeforme* Ravn from upper Danian strata of West Greenland. Kollmann & Peel (1983) regarded these two taxa to be conspecific, thus, the youngest species of *Tylostoma* is *T. ampullariaeforme.*

Pictavia

Pictavia evidently originated during the Late Triassic in western Europe (Cossmann, 1925). During the Middle and Late Jurassic, it was mostly confined to western Europe (Cossmann, 1925), but at least one species occurred in East Africa (Cox, 1965). Near the end of the Jurassic, the genus had been reduced to two known species, one from France and one from the Carpathian Mountains region of eastern Europe (Cossmann, 1925). The Cretaceous record of this genus is sparse. Other than a middle Albian to early Cenomanian species from Austria (Kollmann, 1978), the only other Cretaceous record is *Pictavia* ***santana,*** sp. nov, from the late Turonian of southern California. It represents the youngest record of this genus. The spread of Tethyan forms, like *Pictavia,* into California during the Turonian might, in part, reflect the closing of the connection between the eastern North Pacific and Canadian Arctic seas, and, in part, result from the high sea stand of the Turonian. The Turonian coincided with exceptional warming (Frakes, 1999), which allowed a conspicuous number of Tethyan forms, including rudists, to exist in late Turonian faunas of Oregon and northern California (Saul, 1986). In addition, the seaway across southern Mexico, which persisted through the Turonian, was apparently widest in the Turonian (Imlay, 1944; Alencaster, 1984). This Turonian high-sea stand would have facilitated faunal exchanges between the Old World and the eastern North Pacific Province (Saul, 1986).

Prisconatica

The earliest known record of this genus is *Prisconatica pedernalis* (Gabb, 1869) of middle Albian age from near Arivechi, Sonora, Mexico (Gabb, 1869; King, 1939). The genus is also known from Cretaceous strata near Ollon, Cajatamba Province, coastal central Peru (Gabb, 1877), but the exact age of its occurrence there is not known. From the late Albian to the early Santonian, the paleobiogeographic record of *Prisconatica* is not known. By late Santonian/early Campanian, *Prisconatica* had immigrated to southern California and to Vancouver Island, British Columbia. *Prisconatica* ***hesperia,*** sp. nov., from these two areas is the youngest record of this genus. *Prisconatica* was apparently confined to the New World.

SYSTEMATIC PALEONTOLOGY

Superorder CAENOGASTROPODA? Cox, 1959

Family TYLOSTOMATIDAE Stoliczka, 1868, emended Squires & Saul

[synonym: Tylostomidae Pchelintsev, 1951]

Discussion: Family Tylostomatidae [note: the combining form of the Greek noun *stoma* (mouth) is *stomat-*], in our opinion, is monotypic. There has been considerable uncertainty and instability concerning the systematic placement of *Tylostoma* Sharpe, 1849. Stolickza (1868:294) stated that he did not know of a single genus of Recent gastropods that can be closely compared with *Tylostoma*, and he placed it in his subfamily Tylostominae within family Naticidae Guilding, 1834 (not Forbes, 1838; see Kabat, 2000). Under ICZN Article 36.1, a family-level name is deemed simultaneously established at all levels (e.g., family, subfamily) upon its initial description (ICZN, 1999). Cossmann (1925) placed this genus in family Euspiridae Cossmann, 1907. Pchelintsev (1951) placed *Tylostoma* in his family Tylostomidae Pchelintsev, 1951, but he was unaware that Stoliczka had already used the name. Most modern workers (e.g., Darteville & Brebion, 1956; Ponder & Warén, 1988; Akers & Akers, 1997) have followed Wenz (1941) and placed *Tylostoma* in family Naticidae. Kase (1984) tentatively placed *Tylostoma* in family Naticidae, although he did not state why he regarded this assignment as tentative. Kabat (1991) suggested that *Tylostoma* might not even belong to the Caenogastropoda. Kase & Ishikawa (2003) reported that all Jurassic and Early Cretaceous gastropods previously regarded as naticids belong to Ampullospiridae Cox, 1930. Until more detailed studies are available, however, we are reluctant to implement their all-inclusive taxonomic comment.

Although *Tylostoma* has traditionally been considered to be a naticid, it has characters that set if off from naticids: usually elongate shell, internal varices (commonly two per whorl), and predominantly orthocline growth lines that are prosocline only on the subsutural and basal areas. In addition, *Tylostoma* seems to have a radial aperture, which means that the plane of the aperture is not at an angle to the shell axis (see Linsley, 1977:fig. 1). Kase (1984) also referred to the radial aperture of *Tylostoma*. Using the convention of Linsley (1977:fig. 1), most naticids have a tangential aperture, which means that the plane of the aperture is at an angle to the shell axis but parallel to the substrate. Furthermore, most naticids have a prosocline growth line which results from having a tangential aperture. Linsley (1977) suggested that a tangential aperture gives gastropods a better chance at snugging down to the substrate, in case of attack. Naticids are noted for living in sand (rather than mud) and burrowing through it in search of prey (Kabat, 1990). So, it would seem that the tangential apertural plane and prosocline growth lines of most naticids help streamline them to make better headway through sand. Thus, it would seem that *Tylostoma*, which has a radial aperture and opisthocline-growth lines carried its shell differently than do most naticids. In addition, Texas *Tylostoma* specimens stored at LACMIP are in very fine-grained rock, not in sandstone. Assuming that these specimens underwent burial in place, they would have lived in mud substrate.

In summary, we exclude Tylostomatidae from within the definition and scope of Naticidae, thereby making Tylostomatidae *incertae sedis* within Caenogastropoda. The usually elongate shell, internal varices, orthocline-growth lines, radial aperture, and preference for muddy substrate set *Tylostoma* apart from naticids.

Genus *Tylostoma* Sharpe, 1849 [synonyms: *Varigera* d'Orbigny, 1850a and *Varicigera* Douvillé, 1916]

Type species: *Tylostoma torrubiae* Sharpe, 1849, by subsequent designation (White, 1880:142); Cretaceous, Portugal.

Diagnosis: Shell commonly large, naticiform, elongate to nearly spherical, smooth, spire very low to high, whorls rounded, anomphalous, aperture radial, inner lip simple and commonly covered by thin to rarely thick callus, basal lip broadly curved dorsally, outer lip usually thickened to form internal varices (commonly two per whorl), outer lip occasionally flared, growth lines predominantly orthocline, but prosocline on subsutural and basal areas.

Discussion: Stoliczka (1868:292) reported *Varigera* d'Orbigny, 1850a, to be a junior synonym of *Tylostoma*, and Cossmann (1925:61) agreed. Kabat (1991:437) also included *Varicigera* Douvillé, 1916, as a junior synonym of *Tylostoma*.

There has been some confusion about which species is the type species of *Tylostoma*. Most workers have followed Wenz (1941:1026) and used *Tylostoma globosum* as the type species. This confusion stems from the fact that Sharpe (1849) did not designate a type species for *Tylostoma*, and White (1880:142) incorrectly inferred that Sharpe had designated one; namely, *Tylostoma torrubiae* Sharpe, 1949. According to ICZN Article 69.1.1 (ICZN, 1999), *Tylostoma torrubiae*, however, does become the type species because White stated it was already the type species and he used it as the type. The designation of *Tylostoma globosum* Sharpe as the type species by Wenz (1941:1026), therefore, is invalid. This is fortunate because, as will be discussed in the next paragraph, *T. globosum* is unusually spherical for a *Tylostoma*. Kabat (1991:437) correctly reported the type species to be *Tylostoma torrubiae* Sharpe, 1849.

Tylostoma shows a considerable range in the shape of the last whorl and the height of the spire. *Tylostoma globosum* Sharpe (1849:379, pl. 9, figs. 5, 6), from Turonian strata of Europe and Africa (Pervinquière, 1912; Cossmann, 1925), for example, is nearly spherical, with a very low spire, overlapping whorls, and probably a thickened outer lip (Wenz, 1941:1027, fig. 2941). *Tylostoma cossoni* Thomas, 1890, from Turonian strata in Gabon, Tunisia, Egypt, and Madagascar (Darteville & Brebion, 1956), has a low spire but not as low as on *T. globosum*. *Tylostoma gadensis* Abbass, 1963, from Turonian strata of Sinai, shows a range from a low to a moderately high spire. Most reported species of *Tylostoma* are less globose and have a much taller spire than *T. globosum* (e.g., see Gabb, 1869; Böse, 1910; Cossmann, 1925; Nagao, 1934; Stanton, 1947; Allison, 1955; Abbass, 1963; Kase, 1984; Akers & Akers, 1997), and the two species described herein also have a high spire.

Many specimens of *Tylostoma* are preserved as steinkerns (internal molds). On these internal molds, inner varices are commonly present (each varix probably coincident with longitudinal prominence parallel to growth lines on outer surface of shell). Stoliczka (1868:293) reported, however, that the internal varices are not always present on the spire whorls.

For a discussion of the taxonomic history of *Tylostoma,* see Kase (1984:156). As summarized by him, there has been considerable confusion in the literature regarding whether *Pterodonta* d'Orbigny, 1842, and *Tylostoma* are synonymous, or if *Pterodonta* is so distinctly different as to be in a different family. Stoliczka (1867) believed *Pterodonta* to be congeneric with *Tylostoma.* Stoliczka also believed that *Pterodonta* is a strombid because *Pterodonta* has an expansion of the outer lip and an aperture whose abapical end is notched or produced into a short canal. Although some *Pterodonta* species (e.g., *Pterodonta elongata* d'Orbigny, 1842, and *Pterodonta ovata* d'Orbigny, 1842) do show winglike expansions of the outer lip, the illustration of *Pterodonta inflata* d'Orbigny (1842:219), the species designated by Cossmann (1904) as the type species of *Pterodonta,* unfortunately, only shows the abapertural view, and the aperture does not appear to be expanded. Kollmann (1985:99, figs. 5d, e) provided an apertural view of this species, and the specimen is a tear-drop-shaped steinkern whose aperture is poorly preserved. Wenz (1940) and Kollmann (1985) assigned *P. inflata* to the stromboidean family Colombellinidae Fischer, 1884.

Darteville & Brebion's (1956:41, pl. 3, figs. 4a, b) illustrations of *Pterodonta inflata* do not look like any other illustrations of this gastropod, and we believe their specimen is misidentified as to genus and species and should be placed in *Tylostoma.*

Wenz (1941) listed two subgenera in genus *Tylostoma*: *Tylostoma sensu stricto* and *Stelzneria* Geinitz, 1874 (type species: *Stelzneria cepaceum* Geinitz, 1874, Cenomanian of Europe). *Stelzneria* is based only on its type species (see Wenz, 1941:fig. 2942). Kabat (1991:437) reported that *Stelzneria* is referable to family Stiliferidae H. Adams & A. Adams, 1853. There are no subgenera, therefore, of *Tylostoma.*

According to Kase (1984:157), several other genera have been confused with *Tylostoma,* and he discussed the differences. The most similar of these genera is *Amaurellina* Fischer, 1885 (type species: *Natica spirata* Lamarck, 1804), which is characterized by a narrow and high spire, tabulate whorls, a wide aperture, a narrow umbilicus, and no inner varices. The least similar of these genera is *Pseudamaura* Fischer, 1885, which is characterized by a high spire, channeled suture, commonly occurring spiral sculpture, no umbilicus (or only a small slit), and no inner varices. *Natica bulbiformis* Sowerby, 1832, the type species of *Pseudamaura,* also has tabulate whorls, nearly straight growth lines, and a prominent callus on the inner lip. *Pseudamaura* has traditionally been placed in the Naticidae. The work of Kowalke & Bandel (1996) and Kowalke (1998), however, has shown that *Pseudamaura* has a protoconch different from that of Naticidae, and the genus is now placed in family Pseudamauridae Kowalke & Bandel, 1996. Furthermore, Pseudamauridae has just recently been recognized (Kowalke & Bandel, 1996; Bandel, 1999) as representing probable cerithimorphoid gastropods.

Tylostoma resembles *Pseudotylostoma* Ihering, 1903, which is based only on its type species, *Pseudotylostoma romeroi* Ihering, 1903, from Cretaceous strata of southern Argentina. This species is known from the provincial Rocanéen Stage, which, according to Ameghino (1906), is equivalent to the Cenomanian. Unfortunately, all the published illustrations of *P. romeroi* Ihering (1903:207, pl. 1, fig. 8; Wenz, 1941:fig. 2928) only show the abapertural view of the same steinkern. More specimens are needed to ascertain the full morphology of this genus and to properly establish its taxonomic status.

Tylostoma ***allisoni*** Squires & Saul, sp. nov. (Figures 2–6)

Tylostoma (*Tylostoma*) cf. *T.* (*T.*) *materinum* White. Allison, 1955:428, pl. 44, fig. 16.

Diagnosis: Large *Tylostoma* with shell moderately ovate-elongate, spire high, last whorl with very narrow varix on left side, inner lip with thin callus, outer lip thick, and growth lines mostly orthocline, but prosocline on subsutural and basal areas.

Description: Shell large (up to 123 mm in height), ovate-elongate, and thick. Shell height/shell diameter ratio approximately 2. Spire high, approximately 35% of shell height. Pleural angle approximately 55°. Protoconch missing. Teleoconch whorls seven. Suture moderately impressed. Whorls rounded and smooth; last whorl with

Figures 2–7. Specimens coated with ammonium chloride. Figures 2–6. *Tylostoma* ***allisoni*** Squires & Saul, sp. nov. Figures 2–3. Holytype UCMP 33732, UCMP loc. A-8321, ×0.75. Figure 2. Apertural view. Figure 3. Left-lateral view. Figures 4–6. Paratype CAS 69105, Punta China, Baja California, Mexico, ×0.9. Figure 4. Apertural view. Figure 5. Left-lateral view. Figure 6. Abapertural view. Figure 7. *Tylostoma*? sp. indet., Hypotype UCMP 33741, UCMP loc. A-8317, ×1, abapertural view.

slight shoulder. Specimens with slightly decorticated shells showing one prominent, very narrow varix along peripheral margin on left side of last whorl at exactly 90° to aperture. Anomphalous. Aperture oval, radial, approximately 46% of shell height. Inner lip with thin callus. Outer lip thick. Columella smooth. Growth lines mostly orthocline but prosocline on subsutural and basal areas, with greatest deflection on last whorl periphery.

Holotype: UCMP 33732.

Dimensions of holotype: Specimen of seven whorls, height 123 mm, diameter 58 mm.

Type locality: UCMP A-8321, 31°32′N, 116°39′30″W.

Paratype: CAS 69105.

Geologic age: Late Aptian.

Distribution: Alisitos Formation, upper member, northern Baja California, Mexico.

Discussion: In addition to the holotype and paratype, we were able to identify only one other specimen, which is a former UCMP specimen now stored at SDSNH. This latter specimen, of which the right half of the spire is missing, is from UCMP loc. A-8331. All three specimens of the new species are from the upper member of the Alisitios Formation at Punta China, Baja California, Mexico. The holotype of the new species has been moderately compressed dorsoventrally, thus the left-lateral view shown in Figure 3 looks somewhat narrow.

The new species is closely similar to *Tylostoma miyakoense* Nagao (1934:247–249, pl. 34, figs. 1–7; pl. 35, figs. 1, 1a–c; pl. 39, fig. 3; Kase, 1984:158–159, pl. 26, figs. 1–4) from upper Aptian to lower Albian strata of northeastern Honshu, Japan (Kase, 1984), but the new species differs by having a larger shell, a more slender last whorl (height is approximately 2 times the diameter, rather than 1.6), a narrower pleural angle (55° rather than 75°), and a wider aperture.

The new species is similar to *Tylostoma tumidum* (Shumard, 1853:208, pl. 5, fig. 3; Stanton, 1947:70–71, pl. 53, figs. 6–9; Akers & Akers, 1997:150, fig. 142 [in part]) from Albian strata in Texas and Louisiana (Akers & Akers, 1997), but differs from *T. tumidum* by having an oval rather than a comma-shaped aperture, much narrower varix, and more impressed sutures. The new species is also similar to *Tylostoma kentense* Stanton (1947:69, pl. 52, figs. 4, 5, 10; Akers & Akers, 1997:148, fig. 140 [in part]) from Cenomanian strata of Culbertson County, Texas (Akers & Akers, 1997), but differs from *T. kentense* by having an oval rather than a subquadrate aperture and a thinner callus on the inner lip. In addition, the new species is similar to *Pterodonta*? *gramanensis* Muniz (1993: 125, pl. 12, figs. 4,5) from Campanian to Maastrichitan strata of northeastern Brazil, but differs from *P.*? *gramanensis* by not having a thick callus on the inner lip.

The new species differs from *Tylostoma materinum* White (1887:189, pl. 17, fig. 1; Maury, 1937:196–197, pl. 15, fig. 2, pl. 16, fig. 1) from Cretaceous strata of the Sergipe basin in northeastern Brazil by having a narrower last whorl, a shorter penultimate whorl, and a less dramatiac rise to the adapical end of the outer lip. The exact age of this Brazilian species is not known because of imprecise locality information.

Etymology: Named for Edwin C. Allison, in recognition of his important work on mollusks of the Alisitos Formation.

Tylostoma? sp. indet.
(Figure 7)

Tylostoma (*Tylostoma*) *mutabilis* Gabb. Allison, 1955:428, pl. 44, fig. 8.

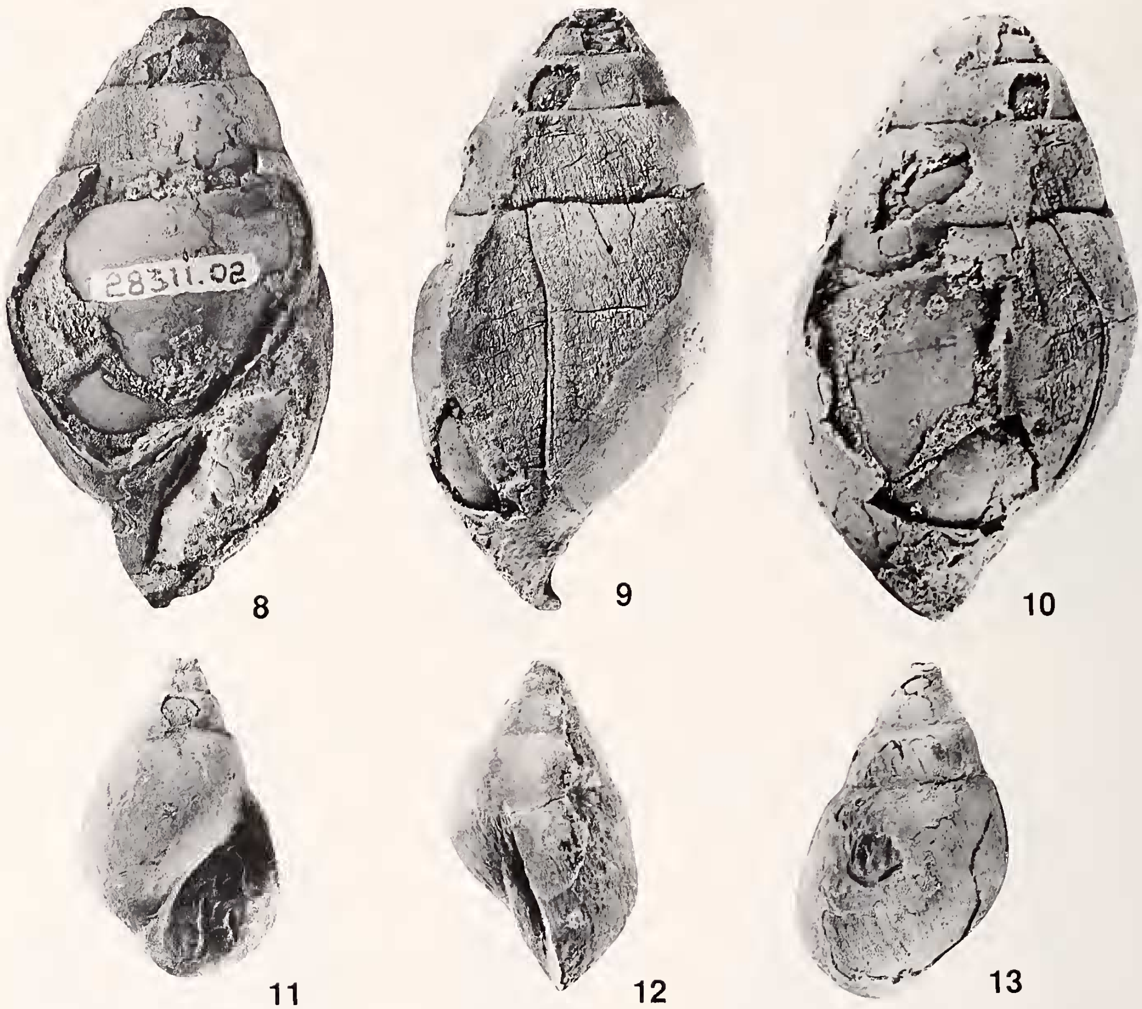
Geologic age: Late Aptian.

Discussion: Only three specimens of this taxon are known. They are all under 36 mm in height and from UCMP loc. A-8317, which is in the upper member of the Alisitos Formation, Baja California, Mexico. The largest specimen is missing half of its shell, and Allison (1955: pl. 44, fig. 8) illustrated the cross-section longitudinal view of this shell. The abapertural side of this specimen is illustrated (Figure 7) for the first time. This side of the specimen, however, underwent considerable damage during cleaning by others, and it is very hard to decipher its morphologic details. The other two specimens are incomplete and also suffered loss of detail by improper cleaning by others. It cannot be determined whether or not they had internal varices. Allison (1955:428, pl. 44, fig. 8) identified these three specimens as *Tylostoma* (*Tylostoma*) *mutabilis* Gabb (1869:261–262, pl. 35, fig. 6a–c; Carreño et al., 1989:174, fig. 58k), a species primarily known from middle Albian strata in the Potrero Formation, near Arivechi, Sonora, Mexico (Gabb, 1869; King, 1939). According to Carreño et al. (1989), the whereabouts of the type material of *T. mutabilis* is unknown. The published illustrations are inadequate and unless topotypic material becomes available, the name is a *nomen dubium.* The small amount of material at hand precludes a determination as to whether these three specimens represent a small-sized species, or if they are just the tips of *Tylostoma* ***allisoni,*** sp. nov. Insufficient morphologic information about these three specimens from the Alisitos Formation makes their generic and specific assignments uncertain.

Tylostoma? *garzana* (Anderson, 1958)
(Figures 8–10)

Phasianella garzana Anderson, 1958:162, pl. 73, fig. 5.

Diagnosis: Large *Tylostoma*? with shell inflated conical-elongate, spire wide and high, spire whorls flattish, last



Figures 8–13. Specimens coated with ammonium chloride. All natural size. Figures 8–10. *Tylostoma*? *garzana* (Anderson, 1958), holotype CAS 28311.02, CAS loc. 28311. Figure 8. Apertural view. Figure 9. Left-lateral view. Figure 10. Abapertural view. Figures 11–13. *Pictavia* ***santana*** Squires & Saul, sp. nov., holotype LACMIP 8127, "narrows" of Silverado Canyon, Santa Ana Mountains, Orange County, southern California. Figure 11. Apertural view. Figure 12. Right-lateral view. Figure 13. Abapertural view.

whorl rounded and smooth with growth lines weakly sinuous.

Description: Shell large (up to approximately 87 mm, estimated, in height), inflated conical-elongate, and thick. Shell height/shell diameter ratio approximately 2. Spire wide and high, approximately one-third of shell height. Pleural angle approximately 67°. Protoconch unknown. Teleoconch whorls six (estimated), smooth. Suture impressed. Spire whorls flattish. Last whorl convex, base rounded. Anomphalous. Aperture lenticular, radial, approximately 56% of shell height; abapical end somewhat excavated and slightly recurved. Growth lines mostly orthocline but prosocline on subsutural and basal areas, with greatest deflection on last-whorl periphery.

Holotype: CAS 28311.02.

Dimensions of holotype: Specimen of 4.5 whorls, 80.1 mm height (upper spire missing), 44.2 mm diameter.

Type locality: CAS loc. 28311.

Geologic age: Late early to early late Maastrichtian.

Distribution: Moreno Formation, "Garzas Sand" member, Los Banos Creek, Merced County, northern California.

Discussion: This species is known with certainty only from the holotype, which shows good preservation. Anderson's illustration of it is highly misleading because, although it appears to be an apertural view, it is actually a left-lateral view with the aperture sketched in. The holotype does not show any evidence of having any varix-like feature on the shell surface. Although this species is very similar in overall shape and size to most high-spired *Tylostoma,* the generic assignment is tentative because when compared to what is normally found on high-spired *Tylostoma,* the spire is wider, the growth line is more sinuous, and there is no evidence of varices. In addition, the abapical end of the aperture of *T.*? *garzana* is slightly recurved. Attempts to find other, unequivocal specimens of this species in museum collections were unsuccessful.

Elder & Miller (1993:15, 27, table 3) reported *Phasianella garzana* from the "Garzas Sand" member at UCMP loc. A-4991. A single specimen was found in the UCMP collection from this locality. The specimen is a poorly preserved steinkern of an incomplete, late-stage juvenile that shows no evidence of internal varices. Only a small remnant of its shell is present, but no growth-line information is evident. The aperture is also very poorly preserved, and the shell, which measures 57.8 mm in height, has been crushed. The specimen can only be tentatively assigned to *T.*? *garzana.*

Tylostoma? *garzana* is similar, especially in terms of overall shape and growth line, to *Tylostoma miyakoense* (Nagao, 1934:247–249, pl. 34, figs. 1–7; pl. 35, figs. 1, 1a–c; pl. 39, fig. 3; Kase, 1984:158–159, pl. 26, figs. 1–4), from upper Aptian to lower Albian strata of northwestern Honshu, Japan (Kase, 1984). *Tylostoma*? *garzana* differs from *T. miyakoensis* by having a slightly larger size, a slightly narrower pleural angle, and a very slight flexure in the growth line.

Tylostoma? *garzana* is also similar to *T.* ***allisoni,*** sp. nov. but differs from the new species by having flatter spire whorls, a wider pleural angle, a less elongate teleoconch, a narrower aperture, and no varix on the shell surface.

Family uncertain
Genus *Pictavia* Cossmann, 1925

Type species: *Natica pictaviensis* d'Orbigny, 1850a, by original designation; Middle Jurassic (Bathonian), southeastern France.

Diagnosis: Shell medium-sized, elongate-oval conical, whorls convex and occasionally subtabulate, spire high, suture grooved to linear, umbilicus slitlike or obsolete, aperture tangential, columellar lip bent over umbilical area, umbilical slit open to concealed, growth lines prosocline.

Discussion: Cossmann (1925), Wenz (1941), and Cox (1965) placed *Pictavia* in family Naticidae. Kabat (1991:434) briefly mentioned that he did not consider *Pictavia* to be a naticid, and he opined that its familial placement is uncertain.

Pictavia shows variation in the depth of its suture. Cossmann (1925) and Wenz (1941), who paraphrased Cossmann's original description, reported a grooved suture for *Picatavia. Pictavia pungens* (Sowerby in Fitton, 1836; Kollmann, 1978:175–176, pl. 1, figs. 8–10), from middle Albian to lower Cenomanian strata of Austria (Kollmann, 1978), however, has a linear suture. The new species described below also has a linear suture, albeit slightly impressed.

Pictavia also shows variation in the development of its umbilical slit. In Cossmann's (1925) description of *Pictavia,* he mentioned that the columellar lip is bent over or wrapped around the umbilicus. He did not indicate that a visible umbilicus is invariably present. In published illustrations of species assigned by him to *Pictavia,* the umbilical slit ranges from clearly present to completely obscured (lacking?). *Pictavia pungens,* for example, mentioned in the above paragraph, has a relatively well developed, but short, umbilical slit. The Late Jurassic *Pictavia clio* (d'Orbigny, 1850a:353; 1850b:199, pl. 292, figs. 1, 2; Cossmann, 1925:pl. 5, fig. 9) has a long umbilical slit. *Pictavia pictaviensis* (d'Orbigny, 1850a:264; 1850b:191–192, pl. 289, figs. 8–10; Cossmann, 1925:pl. 7, fig. 4; Wenz, 1941:fig. 2924), the type species, has an extremely narrow umbilical slit. The Early Jurassic *Pictavia minuta* (Terquem & Piette, 1865; Cossmann, 1925: pl. 4, fig. 19) has its umbilical slit essentially obscured by the slightly projecting inner lip. The Middle Jurassic *Pictavia bajocensis* (d'Orbigny, 1850a:264, 1850b:189, pl. 289, figs. 1, 3; Cossmann, 1925:pl. 5, figs. 22–23) apparently has no umbilical slit. The Middle Jurassic *Pictavia lorierei* (d'Orbigny, 1850a:264; 1850b:190–191, pl. 289, figs. 6, 7; Cossmann, 1885:pl. 16, figs. 36, 37) has no umbilical slit. The new species described below has no umbilical slit.

Pictavia ***santana*** Squires & Saul, sp. nov.
(Figures 11–13)

Diagnosis: Shell medium-sized, moderately slender and elongate, last whorl with slight shoulder and slight basal angulation, inner lip with thin callus, and growth lines prosocline.

Description: Shell medium-sized (up to 46 mm, estimated, in height), elongate, moderately slender, and moderately thick. Shell height/shell diameter ratio approximately 1.6. Spire high, approximately 31% of shell height. Pleural angle approximately 57°. Protoconch and uppermost spire unknown. Teleoconch whorls approximately six (estimated), smooth. Suture slightly impressed to indented. Spire whorls lowly convex. Last whorl rounded, with slight shoulder and indented suture, producing somewhat subtabulate appearance; slight subangulation to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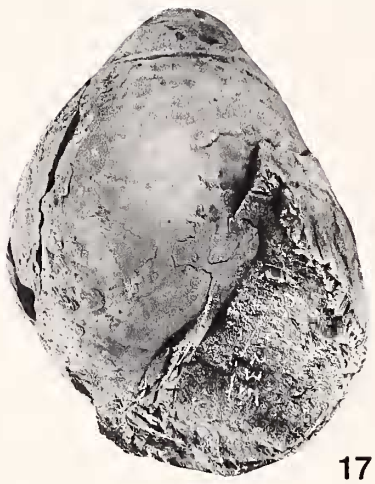
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base. Last whorl approximately 53% of shell height. Anomphalous. Aperture elliptical, posteriorly constricted; tangential, at 45° angle to shell axis of coiling. Inner lip smooth and with moderately thin callus, adaxial margin well delineated; callus becoming faint adapically. Outer lip thin. Columella smooth. Growth lines prosocline.

Holotype: LACMIP 8127.

Dimensions of holotype: Specimen of four whorls, height 44.7 mm (uppermost spire missing), diameter 27.5 mm.

Type locality: Exact location unknown but at the "narrows" of Silverado Canyon, Santa Ana Mountains, Orange County, southern California, 33°44′38″N, 117°38′30″W.

Geologic age: Late Turonian.

Distribution: Ladd Formation, most likely Holz-Baker transition interval, Santa Ana Mountains, Orange County, southern California.

Discussion: Only a single specimen is known of the new species, and it shows good preservation. Stratigraphic information on the label accompanying the specimen indicates that it is from the lower Holz Shale Member of the Ladd Formation, Santa Ana Mountains. Based on the silty, very fine-grained sandstone matrix inside its aperture, it is most likely that the specimen is from the Holz-Baker transition interval at the base of the Holz Shale Member. This particular interval, as well as the immediately overlying and underlying beds, are of late Turonian age (Saul, 1982, fig. 2).

The new species is most similar to the Middle Jurassic *Pictavia bajocensis* (d'Orbigny, 1850a:264; 1850b:189, pl. 289, figs. 1, 3; Cossmann, 1925:pl. 5, figs. 22, 23), but the new species differs by having a narrower shell and more elongate last whorl. The new species is also closely similar to the Middle Jurassic *Pictavia lorierei* (d'Orbigny, 1850a:264; 1850b:190–191, pl. 289, figs. 6, 7; Cossmann, 1885:pl. 16, figs. 36, 37), but the new species differs by having a narrower and slightly higher spire, a more cylindrical and nontabulate last whorl, and an aperture with a rounded (rather than slightly projecting) abapical end.

Etymology: Named for the Santa Ana Mountains, Orange County, southern California.

Genus *Prisconatica* Gabb, 1877

Type species: *Lunatia pedernalis* Gabb, 1869, non *Natica pedernalis* Roemer, 1849, by original designation; Early Cretaceous (middle Albian), near Arivechi, Sonora, western Mexico.

Diagnosis: Shell large, elongate ovoid to tear-drop, whorls overlapping and smooth, umbilicus small to obsolete, aperture radial, columellar lip narrow and raised, growth lines generally prosocline.

Discussion: Kabat (1991:435) reported *Prisconatica* to be of uncertain status, but he did not explain if he meant familial and/or generic status. We believe that only the familial placement is uncertain. Gabb (1877:277–278), in his study of some Peruvian Cretaceous fossils, named *Prisconatica* in order to include a number of Mesozoic naticoid species "characterized by being almost always of large size with very small, or entirely obsolete umbilicus, and in having the columellar lip always thinly encrusted."

When Gabb (1877) proposed the genus name *Prisconatica,* he designated *Natica pedernalis* Roemer, 1849, as the type species but referred to the better figure of it in Gabb (1869:pl. 35, fig. 3). Most illustrations of Roemer's species appear to be of steinkerns which do not show the external shape of the shell. They depict a large naticoid form with tabulate whorls and a moderate umbilicus, which does not agree with Gabb's description of *Prisconatica* as being elongate in shape with nontabulate whorls and a small to obsolete umbilicus. Gabb's description agrees with his figure (Gabb, 1869:pl. 35, fig. 3) of *Lunatia pedernalis* from the Potrero Formation near Arivechi, Sonora, Mexico. Gabb seems to have inferred that the addition of shell material to Romer's steinkern would result in a high spired (for a naticoid), elongate, nontabulate form with a small umbilicus. Stanton (1947), however, having compared many steinkerns from Texas, considered that the whorl profile of *Lunatia*? *pedernalis* (Roemer) was flattened posteriorly and that the specimen Gabb illustrated should be assigned to *Lunatia*? *praegrandis* (Roemer, 1849), on which the whorl profile is more evenly rounded. Subsequent workers mentioning the fauna from the Arivechi area (e.g., King, 1939:1669) have referred to either *Lunatia praegrandis* or *L. pedernalis.* Stanton's revision of the identity of Gabb's specimen

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Figures 14–22. Specimens coated with ammonium chloride. All from GSC loc. 103851, unless otherwise noted. Figures 14–22. *Prisconatica* ***hesperia*** Squires & Saul, sp. nov. Figures 14–16. Holytype RBCM.EH2003.003.0001, ×. 0.9. Figure 14. Apertural view. Figure 15. Right-lateral view. Figure 16. Abapertural view. Figure 17. Paratype RBCM.EH2003.004.0001, ×1, apertural view. Figures 18–19. Paratype RBCM.EH2002.015.0001, ×1. Figure 18. Apertural view. Figure 19. Abapertural view. Figures 20, 21. Paratype RBCM.EH2002.014.0001, × 0.9. Figure 20. apertural view. Figure 21. Abapertural view. Figure 22. Paratype LACMIP 8128, LACMIP loc. 27199, ×1, apertural view.

from Arivechi would appear to make *Natica praegrandis* the type species of *Prisconatica,* but Gabb was clearly aware of both of Roemer's species. When describing *Prisconatica ovoidea* Gabb, 1877, from Peru, he compared it to both *Prisconatica pedernalis* and *Prisconatica praegrandis.* If the large naticoid from the Potrero Formation near Arivechi is neither *Natica pedernalis* Roemer, 1849 nor *Natica praegrandis Roemer,* 1849, then Gabb's 1877 citation of Gabb, 1869:pl. 25, fig. 3 as a better figure of the type species of *Prisconatica* should make *Lunatia pedernalis* Gabb, 1869, non *Natica pedernalis* Roemer, 1849, the type species of *Prisconatica.*

Genera that have been historically confused with *Prisconatica* are *Lunatia* Gray, 1847, *Natica* Scopoli, 1777, and, to a lesser degree, *Tylostoma.* Although some workers (Wrigley, 1949; Akers & Akers, 1997) reported that *Lunatia* is a distinct or possibly distinct genus, many modern workers (e.g., Erickson, 1974) have followed Sohl (1960) and considered *Lunatia* to be congeneric with *Euspira* Agassiz in Sowerby, 1838. The type species of *Euspira* is *Natica glaucinoides* Sowerby, 1812, known from the Paleogene of France and England (Majima, 1989), and Bandel (1999:150) advised that until the protoconch of this species is known, *Euspira* cannot be put into synonymy with *Lunatia. Prisconatica* differs from *Lunatia* and *Euspira* by having a tear-drop shape and no umbilical callus. In addition, shells of these other two genera are usually smaller than those of *Prisconatica. Prisconatica* differs from *Natica* by having a tear-drop shape, a narrower umbilicus with no funicle, no sculpture on the shell, and a much thinner inner lip callus. *Prisconatica* differs from *Tylostoma* by having a tear-drop shape and, in most cases, an umbilicus, and by lacking varices.

Pervinquière (1912:46), who used the name *Natica* (*Prisconatica*) *praelonga* Deshayes in Leymerie, 1842, for an unfigured gastropod from Tunisia, is the only Old World worker to use *Prisconatica.* An illustration by d'Orbigny (1842:151–151, pl. 172, fig. 1), however, shows that *Natica praelonga,* which is primarily known from the Lower Cretaceous (Neocomian) of western Europe and South America (Weaver, 1931) differs significantly from *Prisconatica* by having a shell with an elongate rather than a tear-drop shape, tabulate and non-overlapping whorls, and a wide and deep umbilicus. Cossmann (1925:53) reiterated Pervinquière's citation, but otherwise ignored the name *Prisconatica.* Wenz (1941: 1021) wrongly reported Pervinquière (1912) as the author of *Prisconatica.* Furthermore, he erroneously placed non-tabulate *Prisconatica* in synonymy with *Pseudoamaura* Fischer, 1885, which has strongly tabulate whorls, a deeply and prominently channeled sutural area, and a wide and prominent inner lip callus.

The name *Prisconatica praelonga* was used also by White (1887:186, pl. 16, figs. 1–4) and Von der Osten (191957:585, pl. 65, fig. 8) for Cretaceous gastropods from northeastern Brazil and for Early Cretaceous gastropods from Venezuela, respectively. Both of these so-called *Prisconatica praelonga* differ from *Prisconatica* by not having overlapping whorls nor a tear-drop shape.

A search of the literature revealed certain naticid species that resemble *Prisconatica,* and they are discussed, in ascending stratigraphic order, in the following statements. *Natica klingamanni* Weaver (1931:374–375, pl. 42, figs. 279, 280) from Middle Jurassic strata in central Argentina (Weaver, 1931), differs from *Prisconatica* by having a taller and narrower spire, a less inflated last whorl whose maximum convexity is located more anteriorly, and an umbilicus represented by an elliptical area, rather than a long groove. *Natica marcousana* d'Orbigny (1850a:59; 1850b:216–217, pl. 298, figs. 4, 5; Loriol & Cotteau, 1868:32–34, pl. 3, fig. 11) from Upper Jurassic strata in Yonne, France differs from *Prisconatica* by having spiral sculpture and a much thicker inner lip callus. *Natica* (*Lunatia*) *omecatli* Felix (1891:169, pl. 25, figs. 1, 1a) from Lower Cretaceous strata near Puebla, Mexico, differs from *Prisconatica* by having a smaller shell, a narrower upper spire, a much less inflated last whorl whose maximum convexity is located more anteriorly, a smaller aperture, and a much smaller and much narrower umbilicus. *Tylostoma globosum*? Sharpe, reported and illustrated by Pervinquière (1912:53, pl. 4, fig. 10) from lower Turonian strata in Tunisia, resembles *Prisconatica* but differs from it by having a narrower and apparently taller spire, a much less inflated last whorl whose maximum convexity is located more abapically, a smaller umbilicus, and a less projecting abapical end to the aperture. In addition, *Globiconcha* (*Phasianella*?) *remondii* Gabb (1864:114, pl. 19, fig. 69) from Cretaceous strata near Benicia, northern California, vaguely resembles *Prisconatica.* Gabb's species is known from only an imperfect cast, and he provided only a generalized line drawing of the outline of the specimen. Examination of a plastoholotype in the LACMIP collection revealed that this gastropod differs from *Prisconatica* by having a shell with a moderately globose rather than a tear-drop shape, apparently tabulate to subtabulate whorls, and a carina just adapical of the midpoint of the last whorl.

Prisconatica **hesperia** Squires & Saul, sp. nov.
(Figures 14–22)

Diagnosis: *Prisconatica* with spire becoming wider with increasing shell size, last whorl tear-drop shaped, umbilicus usually narrow or obsolete, aperture comma shaped, and growth lines weakly sinuous.

Description: Shell medium-sized (up to 90 mm, estimated, in height), globose ovoid to tear-drop, smooth, and thick. Shell becoming more globose with growth: shell height/shell diameter ratio approximately 1.7 on juveniles and approximately 1.3 on late-stage adults. Spire narrow, slightly concave in profile, moderately low, becoming relatively lower with growth: spire height approximately 26% of total shell height on juveniles and approximately 14% on late-stage adults. Pleural angle becoming wider with increasing shell size; approximately 62° on juveniles and up to nearly 90° on mature adults. Protoconch unknown. Teleoconch whorls about six, smooth. Suture adpressed? Whorls overlapping nearly half-way. Spire whorls flattish. Last whorl large, very inflated and teardrop shaped; maximum convexity either medially or slightly anterior of medial point; base rounded. Umbilicus usually present, narrow but distinct, and very small or obsolete on some specimens. Aperture comma-shaped, posteriorly somewhat constricted; aperture height usually approximately 64% of shell height. Columella smooth. Columellar lip narrow, smooth, and raised relative to umbilicus. Outer lip slightly tangential. Growth lines weakly sigmoidal on periphery of last whorl, slightly prosocline on remaining part of last whorl.

Holotype: RBCM.EH2003.003.0001 [= VIPM 170].

Dimensions of holotype: Specimen of 3.5 whorls, height 65 mm (upper spire missing), diameter 47 mm.

Type locality: GSC loc. 103851, 49°11′45″N, 124°06′00″W.

Paratypes: RBCM.EH2002.014.0001; RBCM.EH2002. 015.0001; RBCM.EH2003.004.0001 [= VIPM 180]; and LACMIP 8128.

Geologic age: Late Santonian/earliest Campanian to early Campanian.

Distribution: UPPER SANTONIAN/LOWERMOST CAMPANIAN: Upper Haslam Formation at Brannen Lake, west of Nanaimo, along east side of Vancouver Island, British Columbia. LOWER CAMPANIAN: Fossils derived from lower Campanian part of Ladd Formation (upper part of Holz Shale Member) and redeposited in lower upper (possibly middle) Campanian basal conglomerate of Williams Formation, Schulz Member, Santa Ana Mountains, Orange County, southern California.

Discussion: This species is known from 11 specimens: 10 from the Brannen Lake site, upper Haslam Formation, and a single specimen from the Schluz Member (see below). The Haslam Formation material ranges in shell height from 35 mm (incomplete) to 85 mm (incomplete), and some of the specimens have been compacted. The largest specimen is shown in Figures 20, 21. Of the 10 Brannen Lake specimens, five have an umbilicus, although the umbilicus on one of these specimens is very narrow and slitlike (Figure 17). Four of the Brannen Lake specimens have an obsolete umbilicus (e.g., Figure 18), and the remaining one is missing that part of the shell. An early adult specimen (Figure 22) of ***Prisconatica hesperia*** was collected from LACMIP loc. 27199. This locality equals locality F38 of Schoellhamer et al. (1981), which is plotted, on their geologic map, in the basal part of the lower upper (possibly middle) Campanian Schulz Member. It is likely that the specimen represents reworked material from the underlying upper part of the lower Campanian Holz Shale Member (see Saul, 1982). This specimen has an umbilicus.

Prisconatica hesperia is most similar to *Prisconatica ovoidea* Gabb (1877:278, pl. 39, fig. 7) from undifferentiated Cretaceous strata near Ollon, Cajatamba Province, central-coastal Peru, but the new species differs by having a much less inflated last whorl, whose maximum convexity is located more anteriorly, and an umbilicus.

The new species is similar to *Prisconatica pedernalis* (Gabb, 1869:259–260, pl. 35, fig. 3), the type species of *Prisconatica,* but the new species differs by having a taller and narrower spire, nontabulate whorls, a less inflated last whorl, a smaller aperture, an umbilicus, and no parietal callus.

Prisconatica hesperia is somewhat similar to *Lunatia pregrandis* (Roemer, 1849:410; 1852, 42, pl. 4, figs. 6a, b; Stanton, 1947:65–66, pl. 51, figs. 1, 2; Akers & Akers, 1997:157, fig. 151), most commonly found as steinkerns in lower Albian strata of central Texas. The new species differs from *L. pregrandis* by having a smaller shell, narrower upper spire, nontabulate whorls, a much less inflated last whorl whose maximum convexity is located more anteriorly, a comma-shaped rather than an auriform aperture, and a narrower umbilicus.

Etymology: Named for *Hesperia,* one of the Hesperides, or Nymphs of the Setting Sun, who lived in the extreme west near the ocean.

Acknowledgments. We are especially grateful for the loan of specimens collected by Graham Beard (VIPM), Peter Bock (VIPM), and Dr. Joseph Haegert (Victoria Palaeontology Society). Peter Bock and Dr. Joseph Haegert also kindly donated key specimens to serve as type material of ***Prisconatica hesperia.*** Tom Cockburn (Victoria Palaeontology Society) facilitated the loan of specimens. Richard Hebda (RBCM) provided RBCM catalog numbers. We appreciate access to the collections at CAS, CSUF, LACMIP, SDSNH, University of California (Riverside), and UCMP. John Cooper (California State University, Fullerton) kindly allowed the donation of the specimen that is the holotype of *Pictavia* ***santana.*** Lindsey T. Groves (Natural History Museum of Los Angeles County, Malacology Section) provided some difficult-to-obtain literature. David Haasl (UCMP) searched the collections for overlooked, additional specimens. The manuscript benefited from constructive comments by Alan R. Kabat, an anonymous reviewer, and Barry Roth.

LITERATURE CITED

Abbass, H. L. 1963. A monograph on the Egyptian Cretaceous gastropods. United Arab Republic, Geological Survey and Mineral Research Department, Palaeontological Series, Monograph 2, 146 pp., 12 pls.

Adams, H. & A. Adams. 1853–1854. The Genera of Recent Mollusca, Arranged According to Their Organization. John Van Voorst: London. 484 pp.

Akers, R. E. & T. J. Akers. 1997. Texas Cretaceous gastropods.

Houston Gem and Mineral Society, Paleontology Section, Texas Paleontology Series, Publication 6, 340 pp.
Alencaster, G. 1984. Late Jurassic-Cretaceous molluscan paleogeography of the southern half of Mexico. Geological Association of Canada, Special Paper 27:77–88.
Allison, E. C. 1955. Middle Cretaceous Gastropoda from Punta China, Baja California, Mexico. Journal of Paleontology 29: 400–432, pls. 40–44.
Allison, E. C. 1974. The type Alisitos Formation (Cretaceous, Aptian-Albian) of Baja California and its bivalve fauna. Pp. 21–59 in G. Gastil & J. Lillegraven (eds.), Geology of Peninsular California. Pacific Section, AAPG, SEPM, and SEG, Book 37: Los Angeles, California.
Ameghino, F. 1906. Les formations sédimentaires du Crétacé supérieur et du Tertiaire de Patagonie. Anales del Museo Nacional de Buenos Aires, series 3, 8:1–568.
Anderson, F. M. 1958. Upper Cretaceous of the Pacific coast. Geological Society of America Memoir, 71, 378 pp., 75 pls.
Bandel, K. 1999. On the origin of the carnivorous gastropod group Naticoidea (Mollusca) in the Cretaceous with description of some convergent but unrelated groups. Greifswalder Geowissenschaftliche Beiträge 6:143–175, pls. 1–4.
Bengtson, P. 1983. The Cenomanian-Coniacian of the Sergipe basin, Brazil. Fossils and Strata 12:1–78.
Böse, E. 1910. Monografía geológica y paleontológica del Cerro de Muleros, cerca de Ciudad Juárez, Estado de Chihuahua y descripción de la fauna Cretácea de la Encantada, Placer de Guadalupe, Estado de Chichuaha. Boletín del Instituto Geológica de México 25:vii + 193 pp., 48 pls.
Carreño, A. L., M. Del C. Perrilliat, C. G.-Arreola, S. P. Applegate, O. C.-Castañeda & E. M.-Hernandez. 1989. Fosiles Tipo Mexicanos. Universidad Nacional Autonoma de Mexico, Instituto de Geologia, Centenario Instituto de Geologia 1886–1986: Mexico, D. F. 531 pp., 207 figs.
Cossmann, M. 1885. Contribution a l'étude de la faune de l'Étage Bathonien en France (Gastropodes). Mémoires de la Société Géologique de France, Série 3, 3:1–374, pls. 1–18.
Cossmann, M. 1904. Essais de Paléontologie Comparée, tome 6. Privately published: Paris. 151 pp., 9 pls.
Cossmann, M. 1907. Description des gastropodes & pélécypodes. Pp. 6–42, pls. 1–6 in Le Barrêmian Supérieur à Faciès Urgonien de Brouzet-lez-Alais (Gard). Mémiores de la Société Géologique de France, 37.
Cossmann, M. 1925. Essais de Paléoconchologie Comparée, tome 13. Privately published: Paris. 345 pp., 11 pls.
Cox, L. R. 1930. The Mollusca of the Hangu Shales. Memoirs of the Geological Survey of India, Paleontologia Indica, New Series, 15(8):ii + 129–222, pls. 17–22.
Cox, L. R. 1959. Thoughts on the classification of the Gastropoda. Proceedings of the Malacological Society of London 33:239–261.
Cox, L. R. 1960. General characteristics of Gastropoda. Pp. I84–I169 in R. C. Moore (ed.), Treatise on Invertebrate Paleontology, Part I, Mollusca 1. Geological Society of America and University of Kansas Press: Lawrence.
Cox, L. R. 1965. Jurassic Bivalvia and Gastropoda from Tanganyika and Kenya. Bulletin of the British Museum (Natural History) Supplement 1, 213 pp., 30 pls.
Dartevelle, E. & P. Brebion. 1956. Mollusques fossiles du Crétacé de la Côte occidentale d'Afrique du Cameroun à l'Angola. I. Gasteropodes. Annales du Musée Royal du Congo Belge Tervuren, Sciences Géologiques, 15:1–128, 8 pls.
d'Orbigny, A. D. 1842–1843. Paléontologie Française. Terrains Crétacés. Tome 2, Gastéropodes. Arthus-Bertrand: Paris. 456 pp., 148 pls.
d'Orbigny, A. D. 1850a. Prodrome de Paléontologie Stratigraphique Universelle des Animaux Mollusques et Rayonnés, Faisant Suite au Cours Elémentaire de Paléontologie. Tome 2. Masson: Paris. 822 pp.
d'Orbigny, A. D. 1850b. Paléontologie Française. Terrains Jurassiques. Tome 2, Gastéropodes. Masson: Paris. 621 pp., pls. 235–428.
Douvillé, M. H. 1916. Les terrains secondaires dans le Massif du Moghara à l'est de l'isthme de Suez, d'après les explorations de M. Couyat-Barthoux. Paléontologie. 1. Terrains Triassique et Jurassique. Mémories de l'Académie des Sciences de l'Institut de France, série 2, 54:1–184, pls. 1–21.
Elder, W. & J. W. Miller. 1993. Maps and checklists of Jurassic and Cretaceous macrofossil localities within the San Jose 1: 100,000 Quadrangle, California, and discussion of paleontological results. U.S. Geological Survey Open File Report 93-503.
Erickson, J. M. 1974. Revision of the Gastropoda of the Fox Hills Formation, Upper Cretaceous (Maestrichtian) of North Dakota. Bulletins of American Paleontology 66(284):131–253, pls. 14–20.
Felix, J. 1891. Versteinerungen aus der mexicanischen Jura- und Kreide-Formation. Palaeontographica 37:140–199, pls. 22–29.
Fischer, P. 1880–1887. Manuel de Conchyliologie et de Paléontologie Conchyliologique, ou Histoire Naturelle des Mollusques Vivants et Fossiles. Paris. 1369 pp., 23 pls.
Fitton, W. H. 1836. Observations on some of the strata between the Chalk and the Oxford Oolite in the south-east of England (fossiles nommés par J. C. Sowerby). Transactions of the Geological Society of London, series 2, 4:1–406 pp., pls. 7–23.
Forbes, E. 1838. Malacologia Monensis. A Catalogue of the Mollusca Inhabiting the Isle of Man and the Neighboring Sea. John Carfrae & Son: Edinburgh. 63 pp., 3 pls.
Frakes, L. A. 1999. Estimating the global thermal state from Cretaceous sea surface and continental temperature data. Pp. 49–57 in E. Barrera & C. C. Johnson (eds.), Evolution of the Cretaceous Ocean-Climate System. Geological Society of America Special Paper, 332.
Gabb, W. M. 1864. Description of the Cretaceous fossils. California Geological Survey, Palaeontology, 1:57–243, 32 pls.
Gabb, W. M. 1869. Cretaceous and Tertiary fossils. California Geological Survey, Palaeontology, 2:1–299, 36 pls.
Gabb, W. M. 1877. Description of a collection of fossils, made by Doctor Antonio Raimondi in Peru. Journal of the Academy of Natural Sciences of Philadelphia, series 2, 8:263–336, pls. 35–43.
Geinitz, H. B. 1874 [in 1871–1875]. Das Elbthalgebirge in Sachsen. Erster Theil. Der untere Quader. Paleontographica 20(1):1–320, pls. 1–67.
Gemmellaro, G. G. 1878. Sui fossile del calcare cristallino delle Montagne del Casale e di Bellampo nella provincia di Palermo. Giornale di Scienze Naturali ed Economiche, Palermo, 13:116–212, pls. 6–10.
Gradstein, F. M., F. P. Agterberg, J. G. Ogg, J. Hardenbol, P. Van Veen, J. Thierry & Z. Huang. 1994. A Mesozoic time scale. Journal of Geophysical Research, series B, 99:24,051–24,074.
Gray, J. E. 1847. A list of the genera of Recent Mollusca, their synonyms and types. Proceedings of the Zoological Society of London 15:129–219.

GUILDING, L. 1834. Observations on *Naticina* and *Dentalium*, two genera of molluscous animals. Transactions of the Linnean Society of London 17:29–36.

HAQ, B. U., J. HARDENBOL & P. R. VAIL. 1987. Chronology of fluctuating sea levels since the Triassic. Science 235:1156–1167.

IHERING, H. VON. 1903. Les mollusques des terrains crétaciques supérieurs de l'Argentine orientale. Anales del Museo Nacional Buenos Aires, series 3, 2:193–339, pls. 1–2.

ICZN. 1999. International Code of Zoological Nomenclature. 4th ed. The International Trust for Zoological Nomenclature: London. 306 pp.

IMLAY, R. W. 1944. Cretaceous formations of Central America and Mexico. Bulletin of The American Association of Petroleum Geologists 28:1077–1195.

KABAT, A. R. 1990. Predatory ecology of naticid gastropods with a review of shell boring predation. Malacologia 32:155–193.

KABAT, A. R. 1991. The classification of the Naticidae (Mollusca: Gastropoda): review and analysis of the supraspecific taxa. Bulletin of the Museum of Comparative Zoology 152: 417–449.

KABAT, A. R. 2000. Results of the Rumphius Biohistorical Expedition to Ambon (1990, pt. 10 Mollusca, Gastropoda, Naticidae). Zoologische Mededelingen 73(12–33):345–380.

KASE, T. 1984. Early Cretaceous Marine and Brackish-Water Gastropoda from Japan. National Science Museum Tokyo. 263 pp., 31 pls.

KASE, T. & M. ISHIKAWA. 2003. Mystery of naticid predation history solved: evidence from a "living fossil" species. Geology 31(5):403–406.

KING, R. E. 1939. Geological reconnaissance in northern Sierra Madre Occidental of Mexico. Bulletin of the Geological Society of America 50:1625–1722, 9 pls.

KOLLMANN, H. A. 1978. Gastropoden aus den Losensteiner Schichten der Umgebung von Losenstein (Oberösterreich). 2. Teil: Naticidae, Colombellinidae, Aporrhaidae, Ceritellidae, Epitoniidae (Mesogastropoda). Annalen des Naturhistorishcen Museums Wien 81:173–201, pls. 1–5.

KOLLMANN, H. A. 1985. Upper Cretaceous gastropods from excavations for the Highway A10 (Charente, France). Cretaceous Research 6:85–111, figs. 1–6.

KOLLMANN, H. A. 1992. Distribution of gastropods within the Cretaceous Tethyan realm. Pp. 95–128 in New Aspects on Tethyan Cretaceous Fossil Assemblages. Band 9. Schriften reihe der Erdwissenschalfthicken Kommissionen der Österreichische Akademie der Wissenschaften. Austria.

KOLLMANN, H. A. & J. S. PEEL. 1983. Paleocene gastropods from Nûgssuaq, west Greenland. Grønlands Geologiske Undersøgelse Bulletin 146:1–115, 259 figs.

KOWALKE, T. 1998. Palaeontology, protoconch-morphology and systematic position of the genus *Pseudamaura* P. Fischer, 1885 (Caenogastropoda: Pseudamauridae). Neues Jahrbuch für Geologie und Paläontologie, Monatshefte 10:577–586, figs. 1–4.

KOWALKE, T. & K. BANDEL. 1996. Systematik und Paläoökologie der Küstenschnecken der nordalpinen Brandenberg-Gosau (Oberconiac/Untersanton) mit einem Vergleich zur Gstropodenfauna des Maastrichts des Trempbeckens (Südpyrenäen, Spanien). Mitteilungen der Bayerischen, Staatssammlung für Paläontologie und historische Geologie (München) 36:15–71.

LAMARCK, J. B. 1804. Mémories sur les fossiles des environs de Paris. Annales du Muséum National d'Histoire Naturelle, Tome 4:289–298. Les Fréves Levrault: Paris.

LEYMERIE, A. 1842. Mémoire sur le terrain Crétacé du département de l'Aube. Partie 2. Mémoires de la Société Geologique de France 5:1–34, pls. 1–18.

LINSLEY, R. M. 1977. Some "laws" of gastropod shell form. Paleobiology 3:196–206.

LORIOL, P. 1887. Études sur les mollusques des couches coralligense de Valfin (Jura). Mémoires de la Société Paléontologie de Suisse 14(5):121–224, pls. 12–14.

LORIOL, P. & J. COTTEAU. 1868. Monographie paléontologie et géologique de l'etage portlandian du department de l'Yonne. Bulletin de la Société des Sciences Historiques et Naturelles de l'Yonne, série 2, 1:1–260, pls. 1–15.

MAJIMA, R. 1989. Cenozoic fossil Naticidae (Mollusca: Gastropoda) in Japan. Bulletins of American Paleontology 96(331): 1–159, pls. 1–14.

MAURY, C. J. 1937. O Cretaçeo de Sergipe. Serviço Geologico e Mineralogico do Brazil, Monographia 11:1–283, (Atlas) 28 pls.

MUNIZ, G. C. B. 1993. Novos moluscos da Formação Gramame, Cretáceo Superior dos Estados da Paraíba e de Pernambuco, nordeste do Brasil. Universidad Federal de Pernambuco, Departamento de Geologia, Recife. Publicação Especial 1203 pp.

NAGAO, T. 1934. Cretaceous Mollusca from the Miyako District, Honshu, Japan. Journal of the Faculty of Science, The Hokkaido Imperial University, series 4, 2:177–277, 17 pls.

PCHELINTSEV, V. F. 1951. Semeystva Tylostomidae i Trajanellidae Berkhnem Melu Zakavkazyia i srednei Azii [= Families Tylostomidae, Trajanellidae in the Upper Cretaceous of the southern Caucasus and central Asia]. Pp. 255–282, 2 pls. in Research Papers of the Institute of Geology of the Georgian SSR, Tbilisi.

PERVINQUIÈRE, L. 1912. Études de paléontologie tunisienne. II. Gastropodes et Lamellibranches des terrains Crétacés. Direction Générale des Travaux Publics, Carte Géologique de la Tunisie: Paris. i-xiv, 352 pp., (Atlas) 23 pls.

PICTET, F.-J. & G. CAMPICHE. 1863. Description de fossiles de terrain Crétacé de Sainte-Croix. Troisème Série. Onzième Livrasion. Partie 2, no. 8. Pp. 349–412, pls. 77–80, in F.-J. Pictet, matériaux pour la Paleontologie Suisse ou Recueil de Monographies sur les Fossiles du Jura et des Alpes. H. Georg: Genève.

PONDER, W. F. & A. WARÉN. 1988. Appendix. Classification of the Caenogastropoda and Heterostropha—a list of the family-group names and higher taxa. Pp. 288–326 in W. F. Ponder (ed.), Prosobranch Phylogeny. Malacological Review, Supplement 4.

POPVICI-HATZEG, V. 1899. Contribution a l'étude de la faune du Crétacé supérieur de Roumanie, environs de Campulung et de Sinaia. Mémoires de la Société Géologique de France 20, 20 pp.

RAVN, J. P. J. 1902. Molluskerne i Danmarks Kridtaflejringer. II. Scaphopoder, Gastropoder og Cephalopoder. Det Kongelige Danske Videnskabernes Selskabs Skrifter, 6 Raekke, Naturvidenskabelig og Mathematisk Afdeling 11(4):204–270, pls. 1-5. [Also as Mémoires de l'Academic Royale des Sciences et des Lettres de Danemark, Series 6, Section des Sciences, 11(4):204–270, pls. 1–5].

RICCARDI, A. C. 1988. The Cretaceous System of southern South America. The Geological Society of America Memoir 168, 161 pp., 21 pls.

ROEMER, F. 1849. Texas, Mit Besonderer Rucksicht auf Deutsche Auswanderung und die Physischen Verhaltnisse des Landes nach Eigener Beobachtung Geschildert. Adolf Marcus: Bonn. xvi + 464 pp.

ROEMER, F. 1852. Die Kredebildungen von Texas, und ihre Organischen Einschlusse. Adolph Marcus: Bonn. 100 pp., 11 pls.

ROSENKRANTZ, A. 1970. Marine Upper Cretaceous and lowermost Tertiary deposits in West Greenland. Meddelelser fra Dansk Geologisk Forening, Kobenhavn, 19:406–453, figs. 1–16.

SAUL, L. R. 1982. Water depth indications from Late Cretaceous mollusks, Santa Ana Mountains, California. Pp. 69–76, figs. 1–3 in D. J. Bottjer, I. P. Colburn & J. D. Cooper (eds.), Late Cretaceous Depositional Environments and Paleogeography, Santa Ana Mountains, Southern California. Pacific Section, SEPM, Field Trip Volume and Guidebook: Los Angeles, California.

SAUL, L. R. 1986. Pacific west coast Cretaceous molluscan faunas: time and aspect of changes. Pp. 131–135 in P. L. Abbott (ed.), Cretaceous Stratigraphy Western North America. Pacific Section SEPM. Vol. 46: Los Angeles, California.

SAUL, L. R. & R. L. SQUIRES, 2003. New Late Cretaceous cerithiform gasropods from the Pacific slope of North America. Journal of Paleontology 77(3):238–249, figs. 1–25.

SCHOELLHAMER, J. E., J. G. VEDDER, R. F. YERKES & D. M. KINNEY. 1981. Geology of the northern Santa Ana Mountains, California, U.S. Geological Survey Professional Paper 420-D, 109 pp.

SCOPOLI, J. A. 1777. Introductio ad Historiam Naturalem Sistens Genera Lapidum, Plantarum et Animalam. Pragae. 506 pp.

SHARPE, D. 1849. On *Tylostoma,* a proposed genus of gasteropodous mollusks. Quarterly Journal of the Geological Society of London 5(1):376–380, pl. 9.

SHUMARD, B. F. 1853–1854. Paleontology. Description of the species of Carboniferous and Cretaceous fossils collected. Pp. 197–21 in R. B. Marcy (ed.), Exploration of the Red River of Louisiana in the Year 1852. U.S. 32nd Congress, 2nd Session, Senate Executive Document 54, Vol. 8: Washington.

SOHL, N. F. 1960. Archeogastropoda, Mesogastropoda and stratigraphy of the Ripley, Owl Creek, and Prairie Bluff formations. U.S. Geological Survey Professional Paper, 331-A, 151 pp., 18 pls.

SOHL, N. F. 1971. North American Cretaceous biotic provinces delineated by gastropods. Proceedings of the North American Paleontological Convention 50:1610–1638, 13 figs.

SOWERBY, J. C. 1812–1846. The Mineral Conchology of Great Britain. Vols. 1–7. Benjamin Meredith: London. Pp. 1–648.

SQUIRES, R. L. & L. R. SAUL, 2001. New Late Cretaceous gastropods from the Pacific slope of North America. Journal of Paleontology 75(1):46–55, figs. 1–6.

SQUIRES, R. L. & L. R. SAUL. 2003. New Late Cretaceous (Campanian and Maastrichtian) marine gastropods from California. Journal of Paleontology 77(1):50–63, figs. 1–4.

STANTON, T. W. 1947. Studies of some Comanche pelecypods and gastropods. U.S. Geological Survey Professional Paper 211, 256 pp., 67 pls.

STOLICZKA, F. 1867–1868. Cretaceous fauna of southern India. Vol. 2 The Gastropoda. Memoirs of the Geological Survey of India, Palaeontologia Indica, Series 5, 497 pp., 28 pls.

TERQUEM, O. & E. PIETTE. 1865. Le Lias Inférieur de l'est de la France, Comprenant la Meurthe, la Moselle, le Grand-Duché de Luxembourg, la Belgique et la Meuse. Paris. 175 pp., 18 pls.

THOMAS, M. P. 1889–1890. Description des mollusques fossils des terrains crétacés de la région sud des Hauts Plateaux de la Tunisie recueillis en 1885-1886. Pp. 1–405, pls. 12–31 in A. Peron (ed.), Exploration Scientifique de la Tunisie (1889–1893). Imprimerie Nationale: Paris.

VON DER OSTEN, E. 1957. A fauna from the Lower Cretaceous Barranquín Formation of Venezuela. Journal of Paleontology 31(3):571–590, pls. 63–65.

WEAVER, C. E. 1931. Paleontology of the Jurassic and Cretaceous of west central Argentina. Memoirs of the University of Washington 1:1–469, pls. 1–62.

WENZ, W. 1938–1944. Gastropoda. Teil 1: Allgemeiner Teil und Prosobranchia. Pp. 1–1639 in O. H. Schindewolf (ed.), Handbuch de Paläozoologie, Band 6. Gebrüder Borntraeger: Berlin. (Reprinted 1960–1961).

WHITE, C. A. 1880. Description of a very large fossil gasteropod from the State of Puebla, Mexico. Proceedings of the United States National Museum 3:140–142, pl. 2.

WHITE, C. A. 1887. Contribuições á paleontologia do Brazil. Archivos do Museu Nacional do Rio de Janeiro 7:1–273, pls. 1–28. [in Portugese and English; reprinted 1888 with preface by the author, under the title Contributions to the paleontology of Brazil; comprising descriptions of Cretaceous invertebrate fossils, mainly from the provinces of Sergipe, Pernambuco, Para and Bahia]

WRIGLEY, A. 1949. English Eocene and Oligocene Naticidae. Proceedings of the Malacological Society of London 28(1): 10–30, figs. 1–47.

APPENDIX

LOCALITIES CITED

All quadrangle maps listed below are U.S. Geological Survey maps.

3 CAS 28311. [= CAS 29116]. At large exposure of sandstone crossing Los Banos Creek, 2.4 km W of Bench Mark 307, middle of SW 1/4 of NE 1/4 of section 12, T. 11 S, R. 9 E, Ortigalita Peak NW Quadrangle (7.5 minute, 1969, provisional edition, 1984), Merced County, north-central California. Moreno Formation, "Garzas Sand" member. Age: Late early to early late Maastrichtian. Collector: A. Bennison, May, 1935.

GSC 103851. Lower shale quarry, Dumont Road, southwest of Brannen Lake, just west of Nanaimo, British Columbia, Canada (approximate coordinates 49°11′45″N, 124°06′00″W). Upper Haslam Formation. Age: Late Santonian/earliest Campanian. Collectors: G. Beard, Peter Bock, Tom Cockburn, and Dr. Joseph Haegert, 1982 to 2001.

LACMIP 27199. Between Fremont Canyon and Oak Flat along a S fork of Fremont Canyon at about 567 m elevation, 107 m N and 320 m E of SW corner of section 7, T. 4S, R. & W, Black Star Canyon Quadrangle (7.5 minute, 1949), northern Santa Ana Mountains, Orange County, southern California. Williams Formation, Schulz Member. Age: Early late (possibly middle) Campanian. Collectors: W. P. Popenoe & J. E. Schoelhamer. November 28, 1951. [= loc. F38 in Schoellhamer et al., 1981].

UCMP A-4491. Sandstone 76 m above base of "Garzas Sand," middle E 1/2 of section 2, T. 8 S, R. 7 E, Bennett Valley, Orestimba Peak Quadrangle (7.5 minute, 1955). Stanislaus County, north-central California. Moreno Formation, "Garzas Sand" member. Age: Late early to early late Maastrichtian. Collector: D. F. Collins, 1949.

UCMP A-8317, Shore of Punta China, approximately 2 km S of mouth of Río de Santo Tomás, northwestern Baja California, Mexico; poorly sorted dark volcanic breccia overlying third caprinid limestone downward from the top of Punta China section. Alisitos Formation, upper member. Age: Late Aptian. Collector: E.C. Allison, early 1950s (see Allison, 1955:407, fig. 1).

UCMP A-8321. Shore of Punta China, approximately 2 km S of mouth of Río de Santo Tomás, northwestern Baja California, Mexico; gray tuffaceous sandstone approximately 4 m stratigraphically above lowest caprinid limestone = fourth such limestone downward from top of Punta China section. Alisitos Formation, upper member. Age: Late Aptian. Collector: E. C. Allison, early 1950s (see Allison, 1955:407, fig. 1).

UCMP A-8331, Shore of Punta China, approximately 2 km S of mouth of Río de Santo Tomás, northwestern Baja California, Mexico; gray-green to brown tuffaceous siltstone approximately 10 to 15 m stratigraphically above lowest exposures along south side of Punta China. Alisitos Formation, upper member. Age: Late Aptian. Collector: E. C. Allison, early 1950s (see Allison, 1955:407, fig. 1).